REMARKS

The USPTO has requested that the Applicant submit a copy of the *Niederreiter* reference titled "Random Number Generation and Quasi-Monte Carlo Methods," referred to in the specification. A copy of the requested paper is submitted herewith.

The USPTO refers to the use of colored drawings and deems them not essential. Therefore, formal drawings in black and white are submitted herewith. Furthermore, with regard to the drawings, the purpose of Fig's 1, 2, and 3 is to demonstrate visually, the difference between "very non-random" gridding in Figure 1, with "very random" Figure 2, and with the QM technique "slightly non-random" (somewhere in between) in Figure 3. The visuals describe the technique qualitatively, and a quantitative tack is taken in Figure 4.

The plot in Figure 4 gives a numerical example of the efficiency of the QM method when using it for sampling integration. The demonstration is that the error decreases faster using QM, at a rate of 1/N^0.7, instead of the classical "random walk" error reduction of 1/N^0.5. The increased rate of error drop means that fewer samples are needed to reach a confidence level, and this should translate into greater efficiency when applied to multi-dimensional simulation of systems, especially PCB variables. This can be very important because many simulation methods take lots of CPU and real time to execute. Reducing the samples can be very productive.

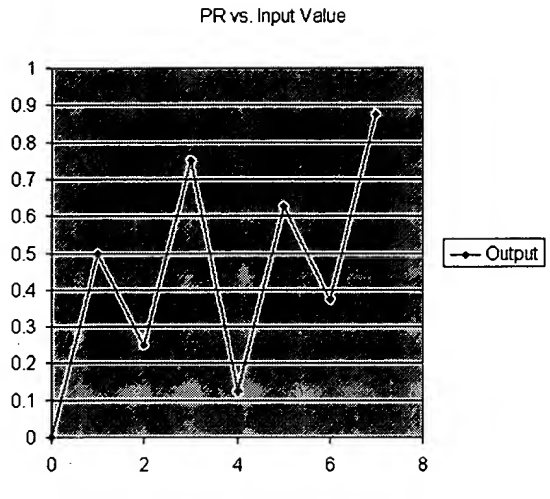
The technique for getting the QM random number generation is using the bit-reversal technique. This has been used and documented since at least 1992, especially for "discrepancy integration". The unique part is to produce mutiple variables (dimensions) from one number, and to use them for PCB simulations.

The USPTO objects to the specification with regard to a discussion of generating a pseudo-random number R with a value between 0 and 1. The key to this pseudo-random mapping is the bit reversal, and the x0, x1, etc. values in the equations refer to the bits as they are numbered conventionally from right to left (A binary number with bits labelled ABCD has x0 = D, x1 = C, x2 = B, and x0 = A). Given a 4-bit binary number, in which the bits are labeled ABCD, the mapping produces a number between 0 and 1 using 0.DCBA.

Example sequence:

Input Number	Mapped Pseudo-Random Value
0 = 0000	0.0000 = 0
1 = 0001	0.1000 = 0.5
2 = 0010	0.0100 = 0.25
3 = 0011	0.1100 = 0.75
4 = 0100	0.0010 = 0.125
5 = 0101	0.1010 = 0.625
6 = 0110	0.0110 = 0.375
7 = 0111	0.1110 = 0.875

....etc. (see plot below)



The main technique in bit-reversal is that the most-frequently changing bits in the lower registers, have the highest weighting in the mapped value. The resolution is indeed 1/(2^N), but the stepping between individual numbers is not 1/(2^N). It is just that the final sequence has the appearance of randomness, as the values do not progress monotonically. Of course, they are not truly random, but only pseudo-random, and they are quasi-Monte Carlo in the sense that their distribution covers the range with more "regularity" than classic Linear Feedback Shift Register PRN generators.

Obviously, if the binary number rolls over (from 1111 to 0000), it will repeat the sequence, but this is normal for pseudo-random number generators. A normal method to prevent this from happening is to pick a large enough number of bits long enough to produce the required quantitiy of PR numbers without causing a rollover. If we need 1000 PR numbers, we could use 10 bits, as this would cover 1024 values before rollover occurred.

Claims 1-22 are rejected under 35 U.S.C. §101 as claiming an invention directed to non-statutory subject matter. Claims 1-22 are rejected under 35 U.S.C. §112 as containing subject matter not sufficiently described in the specification. Claims 2-5, 9-

10, 12-15 and 19-22 are rejected under 35 U.S.C. §112 as being indefinite. Claims 1-8 and 11-18 are rejected under 35 U.S.C. §102 as disclosed by the Applicant's admissions. The foregoing rejections are submitted to be overcome for the reasons set forth below.

The statement "where N is the number of pseudo-random numbers". It should be read "where N is the number of bits and P^N is the number of pseudo-random numbers...".

The idea behind this is to prevent rational fractional mapping of random numbers, which would lead to "gridding". For instance, suppose we have two dimensions in which to map random numbers, and we pick the number of target values, s, for each dimension as 16, and the binary number we use is 7 bits long, with 128 unique values.

For the above example, s^D would be 16^2, or 256 total target values. In this case, r would be 256/128, or 2. The 128 possible numbers from the sequence would then map into half of the target points, but would then be too regular of a grid, exactly picking every other point in the target (if you used all 128 values), and, more importantly, exactly avoiding every other point. This would be too regular, and resemble a grid method, and would preclude sampling some possible important areas. In order to break this up, the ratio, r, should not be 2, as in this case, but some number large enough to prevent repeatable gridding. Avoiding small factors such as 2, 4, or 8, (or other factors of s), can be done by picking a relatively large r value that is prime and that would not include those factors.

Also, one normally wants the sampling using a random-number technique to pick a subset of all possible values. Choosing r to be 37, for instance, would cover 1/37th of the target points if all random numbers (0 to P^N) were used.

The terminology "very non-random correlations" refers to rational fractional mapping, or "gridding". As such, the calculation for s = (rP^N)^(1/D) is to prevent a user from getting too regular of a sample pattern.

The USPTO has stated that the application contains some potentially patentable material; specifically, claims 9, 10, 19, 20, 21 and 22. Therefore, claim 9 and its intervening claims are combined into independent claim 1. Claim 19 and its intervening claims are combined into independent claim 11.

Furthermore, claims 2-6, 8, 9, 12-16, 18 and 19 are cancelled. The rejected claims 10, 11, 20, 21 and 22 are amended to overcome the objection to the negative limitation "deriving the value of S such that a ratio r is not factorable."

The rejected claims are amended to incorporate the claims not rejected by the prior art and are submitted for reconsideration and allowance. Furthermore, the objections to the specification are submitted to be overcome.

Claims 1, 10, 11, 20 and 21 include: "wherein S is the resolution of each dimension and a ratio r as defined by the equation $r = s^D/P^N$ can be predetermined to be a prime number so that a value for S then can be derived from the equation for r."

The PTO provides in MPEP § 2131..."To anticipate a claim, the reference must teach every element of the claim...". Therefore, to sustain this rejection the *Niederreiter* reference must contain all of the claimed elements of independent claims 1, 10, 11, 20, 21 and 22. However, the claimed invention is not shown or taught in the *Niederreiter* reference. Therefore, the rejection is unsupported by the art and should be withdrawn.

> "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described in a single prior art reference." *Verdegaal Bros. V. Union Oil Co. Of California,* 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)." "The identical invention must be shown in as complete detail as contained in the ...claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Applicants further traverse this rejection on the grounds that the reference is defective in establishing a prima facie case of obviousness.

As the PTO recognizes in MPEP § 2142:

> ... The examiner bears the initial burden of factually supporting any prima facie conclusion of obviousness. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness...

The Federal Circuit has held that a reference did not render the claimed combination *prima facie* obvious in *In re Fine*, 873 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988), because inter alia, the examiner ignored a material, claimed, temperature limitation which was absent from the reference. In variant form, the Federal Circuit held in *In re Evanega*, 829 F.2d I 110, 4 USPQ2d 1249 (Fed. Cir. 1987), that there was want of *prima facie* obviousness in that:

> The mere absence [from the reference] of an explicit requirement [of the claim] cannot reasonably be construed as an affirmative statement that [the requirement is in the reference].

In *Jones v. Hardy*, 727 F.2d 1524, 220 USPQ 1021 (Fed. Cir 1984), the Federal Circuit reversed a district court holding of invalidity of patents and held that:

> The "difference" may have seemed slight (as has often been the case with some of history's great inventions, e.g., the telephone) but it may also have been the key to success and advancement in the art resulting from the invention. Further, it is irrelevant in determining obviousness that all or all other aspects of the claim may have been well known in the art.

The Federal Circuit has also continually cautioned against myopic focus on the obviousness of the difference between the claimed invention and the prior art rather than on the obviousness vel non of the claimed invention as a whole relative to the prior art as §103 requires. See, e.g., *Hybritech Inc. v. Monoclonal Antibodies, Inc.* 802 F.2d 1367, 1383, 231 USPQ 81, 93 (Fed. Cir. 1986).

In the present case, the reference fails to teach or suggest all the limitations of the claimed invention. Thus, the rejection is improper because, when evaluating a claim for determining obviousness, all limitations of the claim must be evaluated. In this context, 35 USC §103 provides that:

> A patent may not be obtained ... if the differences between the subject matter sought to be patented and the prior art are such that the *subject matter* as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains ... (Emphasis added)

Because all the limitations of claim 1, 10, 11, 20, 21 and 22 have not been met by the *Niederreiter* reference, it is impossible to render the subject matter as a whole obvious. Thus the explicit terms of the statute have not been met and the examiner has not borne the initial burden of factually supporting any *prima facie* conclusion of obviousness.

The amendments herein are fully supported by the original specification and drawings, therefore no new matter is introduced.

In view of the above, it is respectfully submitted that claims 1, 7, 10, 11, 17 and 20-22 are in condition for allowance. Accordingly, an early Notice of Allowance for the remaining claims is courteously solicited.

Respectfully submitted,

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